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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/662,875	09/16/2003	David L. O'Meara	071469-0305306	1166

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EXAMINER	
NGUYEN, TUAN H	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 03/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/662,875	O'MEARA ET AL.	
	Examiner	Art Unit	
	Tuan H. Nguyen	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 December 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-38* is/are pending in the application.

4a) Of the above claim(s) *34-38* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-33, drawn to method for forming a microstructure, classified in class 438, subclass 758+.

II. Claims 34-38, drawn to A processing tool, classified in class 700, subclass 90+.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case the apparatus as claimed can be used to practice another and materially different process such as: the interfacial oxide layer could be grew before the step of depositing a high-k layer by using the same processing tool.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Applicant is advised that the reply to this requirement to be complete must include an election of the invention to be examined even though the requirement be traversed (37 CFR 1.143).

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

During a telephone conversation with Mr. Karceski on 3/15/05 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-33. Affirmation of this election must be made by applicant in replying to this Office action. Claims 34-38 have been withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claim Objections

Claim 31 is objected to because of the following informalities: Claim 31 is depended on itself. Should it be depended on claim 30?. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 1-5, 10-12, 15-19, 21-29 are rejected under 35 U.S.C. 102(b) as being anticipated by Maiti et al..

See Maiti et al., figs. 1-3 and related text on col. 2-4 which discloses the claimed method for forming a microstructure including the steps of providing a silicon substrate 12; forming a diffusion filter layer 14 on the silicon substrate 12 (fig. 1); depositing a high-k layer 16 onto the diffusion filter layer 14; and performing an oxidation process after the depositing wherein the growth of an interfacial oxide layer being controlled (limited or eliminated, see col. 2, lines 51-53, and claim 7, last two lines) by the diffusion coefficient of the diffusion filter layer 14.

With respect to claims 2-5, see col. 3, first paragraph for the process of nitridation to form diffusion filter layer 14 of nitride or silicon oxynitride.

With respect to claim 10-11, see col. 3, lines 15-19 for the thickness of the diffusion filter layer 14 is between 2-15 angstroms and the combined thickness of the diffusion filter layer and the interfacial oxide layer is generally less than 20 angstroms, considering the thickness of the interfacial oxide layer is limited or eliminated.

With respect to claims 12, 15, see col. 4, lines 10-14 for the oxygen anneal or other anneal process following the formation of the high-k dielectric layer 16.

With respect to claims 16-19, see col. 3, third paragraph for the step of depositing high-k material.

With respect to claims 21-23, see col. 4, third paragraph for the step of forming an electrode layer 20 on the high-k layer 16, and subsequently annealing to form salicide layer 20a.

With respect to claim 24, the plasma nitridation to form the diffusion filter layer of silicon nitride is a self-limiting process due to the prevention of silicon exposure at a certain thickness of silicon nitride layer.

With respect to claims 27, 29, the diffusion coefficient of the diffusion filter layer is determined in order to limit or eliminate the growth of interfacial oxide layer so that the predetermined thickness of the high-k layer will not be changed in the oxidation process (col. 4, first and second paragraphs).

With respect to claim 28, see col. 2, last paragraph.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 6-9, 13-14, 20, 30-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti et al. in view of Ballantine et al..

Maiti et al., figs. 1-3 and related text on col. 2-4, discloses substantially the claimed method for forming a microstructure including the steps of providing a silicon substrate 12; forming a diffusion filter layer 14 on the silicon substrate 12 (fig. 1); depositing a high-k layer 16 onto the diffusion filter layer 14; and performing an oxidation process after the depositing wherein the growth of an interfacial oxide layer being controlled (limited or eliminated, see col. 2, lines 51-53, and claim 7, last two lines) by the diffusion coefficient of the diffusion filter layer 14, as explained above.

With respect to claim 30-32, Maiti et al. is silent about the oxidation process occurs during the deposition of the high-k layer; however, during depositing metal oxide gate layer 16 by the deposition 18 of a metal film followed by an oxidation step. The oxidation temperature is obviously to be less than 1000°C (col. 3, third and fourth paragraphs), the interfacial oxide layer is inherently grew by the oxidation process with or without oxygen containing gas since the oxygen source is provided from the metal oxide gate layer 16.

Maiti et al. is silent about the use of inert gas in the nitridation and oxidation process, process temperatures, others deposition process for forming the diffusion filter layer.

Ballantine et al., in a related art as shown in figs. 1-2 and text on col. 1-6, teaches the use of inert gas in the nitridation process for forming ultra-thin interfacial layer 14 (col. 5, third paragraph); and col. 5, sixth paragraph discloses the substrate temperature for carrying out the nitridation process.

With respect to claim 20, see col. 4, lines 48-54

With respect to claim 33, see col. 1, line 60 to col. 2, line 5 for the function of the interfacial layer.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the teachings from Ballatine et al. in Maiti et al. process for nitridation and oxidation since inert gas is a well-known carrier gas, and temperature of less than 1000°C is a well-known temperature for carrying out nitridation and oxidation in semiconductor processing art.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Rotondaro et al. discloses the formation of nitride passivation layer under the high-k layer for preventing the formation of a thick oxide interface layer. Note in paragraph[0026] for the well-known oxidation temperature.

Green et al., Gartner et al., Oh et al., O'Meara et al., and Hattangady et al. disclose related methods.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan H. Nguyen whose telephone number is 571-272-1694. The examiner can normally be reached on 9AM-5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Tuan H. Nguyen
Primary Examiner
Art Unit 2813